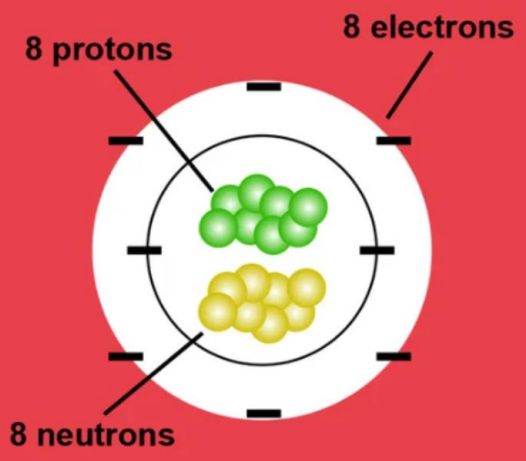
ATOMS AND MOLECULES

ATOM

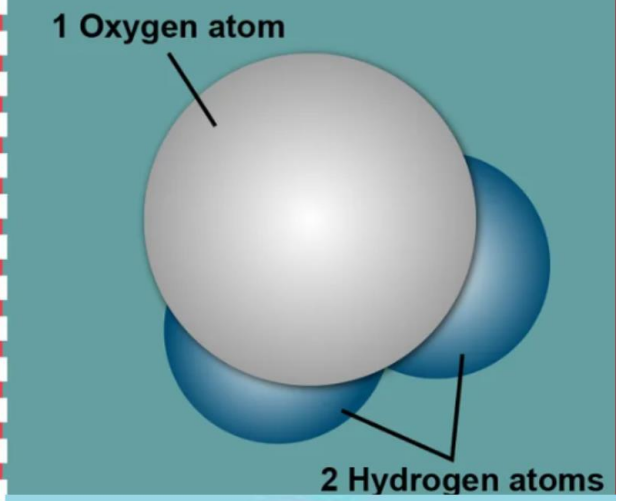


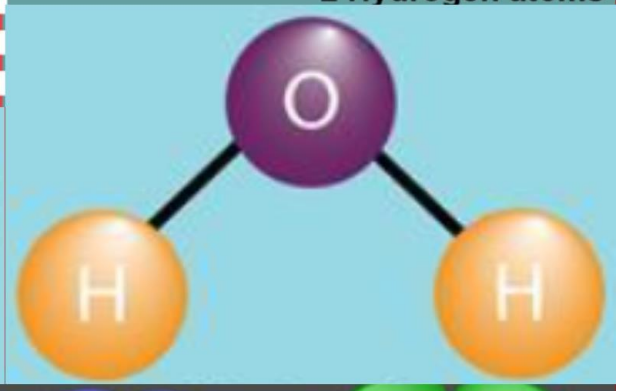
OXYGEN

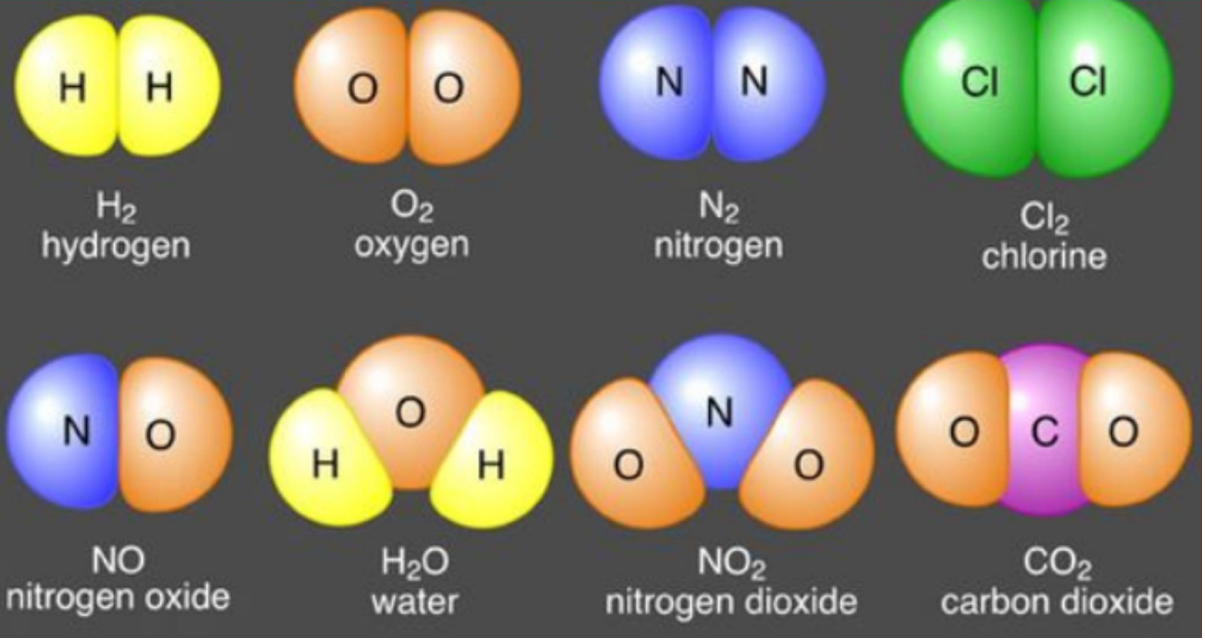


Atoms

MOLECULE







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CHAPTER 3

ATOMS AND MOLECULES

Atoms: Atoms are the smallest particles of an element which can take reaction.
Size of an atom: atomic radius is measured in nanometers.
1nm = 10^{-9}m
Atomic radii of hydrogen atom = 1×10^{-10} m.
Symbols of atoms:

Name of the element	Atomic Number	Symbol
Hydrogen	1	H
Helium	2	He
Lithium	3	Li
Beryllium	4	Be
Boron	5	B
Carbon	6	C
Nitrogen	7	N
Oxygen	8	O
Fluorine	9	F
Neon	10	Ne
Sodium	11	Na
Magnesium	12	Mg
Aluminium	13	Al
Silicon	14	Si
Phosphorous	15	P
Sulphur	16	S
Chlorine	17	Cl
Argon	18	Ar
Potassium	19	K
Calcium	20	Ca

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Molecules: Molecules are the smallest particle of an element or a compound which can exist independently. Molecules may be monoatomic, di-atomic or polyatomic.
Atomicity: The number of atoms constituting a Molecule is known as its atomicity.

Name of the element	Atomicity	Molecules formula
Helium	Diatomic	He
Neon	Monoatomic	Ne
Argon	Monoatomic	Ar
Sodium	Monoatomic	Na
Aluminium	Monoatomic	Al
Hydrogen	Diatomic	H_2

Nitrogen	Diatomic	N_2
Oxygen	Diatomic	O_2
Chlorine	Diatomic	Cl_2
Phosphorous	Polyatomic	P_4
Sulphur	Polyatomic	S_8

Law of Chemical Combination:
(i) Law of conservation of mass: Mass can neither be created nor destroyed in a chemical reaction. For example,

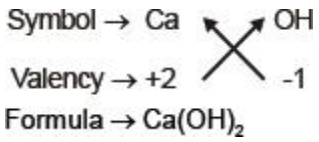
A+B $\longrightarrow$ C+D
Reactants Products
Mass of reactants = Mass of products

(ii) Law of constant proportion: In a chemical substance the elements are always present in definite proportions by mass. For example, in water,
The ratio of the mass of hydrogen to the mass of oxygen is always 1: 8 respectively.

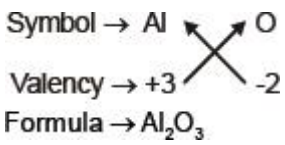
Chemical Formulae:

(i) The valences or charges on the ion must balance.
(ii) A metal and non-metal compound should show the name or symbols of the metal first. For example, $Na^+ Cl^- \rightarrow NaCl$
(iii) If a compound consists of polyatomic ions. The ion before writing the number to indicate the ratio. For example, $[H]^+[SO_4]^{2-} \rightarrow H^+ SO_4^{2-} \rightarrow H_2SO_4$.

Chemical formula of some simple compounds
(a) Calcium hydroxide



(b) Aluminium oxide



Atomic mass: Atom - Atomic mass
Molecular Mass: Molecule - Molecular Mass

Molecular Mass: It is the sum of the atomic masses of all the atoms in a molecule of the substance. It is expressed in atomic mass unit (u). For example,

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$2H_2 + O_2 \longrightarrow 2H_2O$
$H_2O = 1 \times 2 + 16 = 18$ u

Formula Unit Mass: It is the sum of the atomic masses of all atoms in a formula unit of a compound. The constituent particles are ions. For example,

$Na^+ + Cl^- \rightarrow NaCl$

$1 \times 23 + 1 \times 35.5 = 58.5$ u

ASSIGNMENT:

MULTIPLE CHOICE QUESTIONS:

1. The atomic symbol of gold is ————————

(a) Si

(b) S

(c) Ag

(d) Au

Ans: (d)

2. The atomic symbol of Mercury is ————————.

(a) H

(b) He

(c) Hg

(d) M

Ans: (c)

3. Which of the following is the incorrect pair of atoms and its atomic symbol?

(a) Sulphur – S

(b) Potassium – P

(c) Phosphorus -P

(d) Sodium- S

Ans: (b) & (d)

4. Atomic mass of Chlorine is ———— (u)

(a) 34

(b) 34.5

(c) 35

(d) 35.5

Ans: (d)

5. The formula of Ammonium Sulphate is ————

(a) NH_4SO_4

(b) NH_4SO_2

(c) $(NH_4)_2SO_4$

(d) NH_2SO_4

Ans: (c)

6. What is the chemical formula of sodium bicarbonate?

(a) Na_2CO_3

(b) $NaHCO_3$

(c) $NaCO_3$

(d) Na_2HCO_3

Ans: (b)

7. A box contains some identical red colour balls labelled as A each weighing 2 g. Another box contains identical blue-coloured balls, labelled as B, each weighing 5 g. In the combinations AB, AB_2, A_2B and A_2B_3 which is applicable?

(a) Law of Definite proportion

(b) Law of multiple proportion

(c) Law of conservation of mass

(d) None of the above

Ans: (b)

8. What is the value of Avogadro's number?

(a) 6.022×10^{-23}

(b) 6.022×10^{23}

(c) 6.022×10^{-22}

(d) 6.022×10^{22}

Ans: (b)

9. An element X is divalent and another element Y is tetravalent. The compound formed by these two elements will be:

(a) XY

(b) XY_2

(c) X_2Y

(d) XY_4

Ans. (c) X_2Y

10.In a reaction, 5.3 g of sodium carbonate reacted with 6 g of acetic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium acetate.

Show that these observations are in agreement with the law of conservation of mass.

sodium carbonate + acetic acid → sodium acetate + carbon dioxide + water

Ans. Sodium carbonate + acetic acid → Sodium acetate + carbon dioxide + water

5.3g 6g 8.2g 2.2g 0.9g

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As per the law of conservation of mass, the total mass of reactants must be equal to the total mass of products

As per the above reaction, LHS = RHS i.e., 5.3g + 6g = 2.2g + 0.9 g + 8.2 g = 11.3 g

Hence the observations are in agreement with the law of conservation of mass.

11. Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?

Ans. We know hydrogen and water mix in the ratio 1: 8.

For every 1g of hydrogen, it is 8g of oxygen.

Therefore, for 3g of hydrogen, the quantity of oxygen = 3 x 8 = 24g

Hence, 24g of oxygen would be required for the complete reaction with 3g of hydrogen gas.

12.Define the atomic mass unit.

Ans. An atomic mass unit is a unit of mass used to express weights of atoms and molecules where one atomic mass is equal to 1/12th the mass of one carbon-12 atom.

13. Write down the formulae of

(i) sodium oxide

(ii) Aluminium chloride

(iii) sodium sulphide

(iv) magnesium hydroxide

Ans. The following are the formulae:

(i) sodium oxide – Na_2O

(ii) Aluminium chloride – $AlCl_3$

(iii) sodium sulphide – Na_2S

(iv) magnesium hydroxide – $Mg(OH)_2$

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14. Write down the names of compounds represented by the following formulae:

(i) $Al_2 (SO_4)$

(ii) $CaCl_2$

(iii) $K_2 SO_4$

(iv) KNO_3

(v) $CaCO_3$.

Ans. (i) $Al_2(SO_4)_3$ – Aluminium sulphate

(ii) $CaCl_2$ – Calcium chloride

(iii) K_2SO_4 – Potassium sulphate

(iv) KNO_3 – Potassium nitrate

(v) $CaCO_3$ – Calcium carbonate

15. Calculate the molecular masses of

H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.

Ans. The molecular mass of H_2 – 2u

The molecular mass of O_2 = 2 x 16u = 32u

The molecular mass of Cl_2 = 2 x 35.5u = 71u

The molecular mass of CO_2 = 12 + (2 ×16) u = 44u

The molecular mass of CH_4 = 12 + (4 x 1) u = 16u

The molecular mass of C_2H_6 = (2 x 12) + (6 x 1) u=24+6=30u

The molecular mass of C_2H_4 = (2 x 12) + (4 x 1) u=24+4=28u

The molecular mass of NH_3 = (14 + 3 x 1) u= 17u

The molecular mass of CH_3OH = (12 + 3×1+16+1) u = 32u

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